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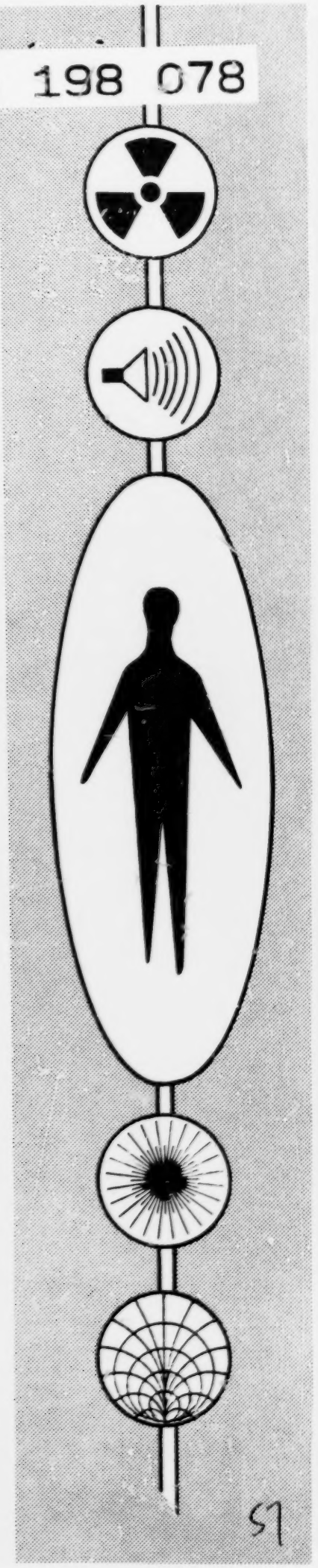
Radiation Incidents Registry Report 1970



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The Radiation Incidents Registry established by the Bureau of Radiological Health has, after one year of operation, provided data on 209 reported incidents and reported potential incidents resulting from exposure to ionizing and nonionizing radiation and ultrasonic waves. These incidents include potential and overt biological injuries to 276 individuals.

Approximately 210 persons were reportedly exposed to electronic product radiation prior to the passage of the "Radiation Control for Health and Safety Act of 1968," and 66 have been reportedly exposed since October 18, 1968. No exposures to children under age 16 were reported. Fifty-seven individuals between the ages of 31 and 44 were reportedly exposed. Over age 45, 36 individuals were involved. Age data on the remaining individuals were not available. There were 200 males, 31 females, and 45 whose sex was not reported.

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Radiation Incidents Registry Report

1970

Loren F. Mills
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Division of Biological Effects

December 1970

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of Radiological Health
Rockville, Maryland 20852

FOREWORD

The Bureau of Radiological Health conducts a national program to limit man's exposure to ionizing and nonionizing radiation. To this end, the Bureau (1) develops criteria and recommends standards for safe limits of radiation exposure, (2) develops methods and techniques for controlling radiation exposure, (3) plans and conducts research to determine health effects of radiation exposure, (4) provides technical assistance to agencies having radiological health programs, and (5) conducts an electronic product radiation control program to protect the public health and safety.

The Bureau publishes its findings in appropriate scientific journals and technical report series for the Bureau's divisions, offices, and laboratories.

The technical reports published by the Division of Biological Effects contain information generated by the Division staff which is timely and useful to the radiological health program. Subjects covered by these reports are varied, for the Division is charged with developing--through animal investigations and population studies--knowledge of the biological effects of radiation delivered to man from his environment and from his use of substances and devices that emit radiation. The reports are distributed to persons and repositories that have expressed an interest in the biological effects of radiation; in addition, the reports are available from the National Technical Information Service.

Readers are encouraged to report omissions or errors to the Bureau. Additional comments or request for further information are also solicited.

John C. Villforth
Director
Bureau of Radiological Health

PREFACE

Radiation emitted from electronic products is a source of exposure to man. For some products, such as medical and dental x-ray machines, the primary radiation emission is useful to man. However, other products emit radiation which serve no useful purpose. The number and types of electronic products capable of emitting radiation is increasing and certain safeguards must be maintained to insure safety in the use of such products.

For this purpose the Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) was enacted to provide for the establishment by the Secretary, Department of Health, Education, and Welfare of an electronic product radiation control program. The Bureau of Radiological Health was given the responsibility for fulfilling the requirements of the Act. Electronic products capable of emitting ionizing or nonionizing electromagnetic or particulate radiation, or any sonic, infrasonic, or ultrasonic wave are subject to investigation and radiation control.

As a means of assisting in the appraisal of the incidence of biological effects in humans, resulting from electronic product radiation, the Bureau of Radiological Health has established the Radiation Incidents Registry. The Division of Biological Effects has been designated as the central contact point for data collection and analysis. The Registry's findings are included in the Annual Report prepared and submitted by the Secretary to the President for transmittal to Congress on the administration of the Act.

This document discusses methods of data collection and presents the incidents reported to the Radiation Incidents Registry during its first year of operation. Individuals who have knowledge of incidents resulting from exposure to electronic product radiation are requested to submit such information to the Registry.

William A. Mills

William A. Mills, Ph.D.
Director
Division of Biological Effects

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RADIATION INCIDENTS REGISTRY REPORT 1970

INTRODUCTION

The Radiation Incidents Registry was established as a corollary to the Radiation Control for Health and Safety Act of 1968 (Public Law 90-602). Section 360D(a) requires "a thorough appraisal (including statistical analyses, estimates, and long-term projections) of the incidence of biological injury and effects, including genetic effects, to the population resulting from exposure to electronic product radiation, with a breakdown, insofar as practicable, among the various sources of such radiation."

The Registry is intended to provide information related to the assessment of the effects of electronic product radiation on humans, including short-term reactions such as skin irritations and long-term disorders such as cataracts and leukemia. It also helps in establishing priorities for electronic product radiation control and in identifying groups for epidemiologic investigation of possible biological effects resulting from exposure to radiation.

The following criteria have been established for reporting radiation incidents from electronic products:

1. Instances in which a person or persons were known to be exposed to radiation in excess of established allowable limits and a biological effect was reported.

2. Unexpected injuries, latent biological effects, or deaths attributed to radiation exposure.

3. Potentially injurious situations where (a) the person(s) lacked the knowledge necessary for the safe operation of a radiation producing device, or (b) unknown or excessive amounts of radiation were emitted from the device but no biological effect was noted.

During 1969, the Bureau of Radiological Health examined various means for providing efficient and reliable data collection for the Radiation Incidents Registry. It was determined that the primary agencies to which reports of radiation incidents should be sent would be the State radiation control programs; and the Epidemiologic Studies

Branch, Division of Biological Effects, would be the central contact point for data collection and analysis. In December 1969, the Radiation Incidents Registry began operation.

The reported radiation incidents presented in this initial report are from two chronological periods: (1) incidents that occurred prior to the passage of the Radiation Control for Health and Safety Act of 1968 (these are included for historical purposes) and (2) incidents that occurred after the Act was passed. Incidents documented in the Bibliography, Appendix A, were collected from a review of the available professional literature and include incidents from both periods. All reported actual and potential incidents accumulated by the Registry through December 1970 are listed in the tables in Appendix B.

METHODOLOGY

A covering letter and placard were sent initially to approximately 2,500 individuals and professional groups. Additional requests for the placard increased the distribution to over 4,500 copies. The covering letter (Appendix C, Exhibit A) described the nature and purpose of the Registry and requested that the placard (Appendix C, Exhibit B) be posted in a conspicuous location for an extended period of time. The placard describes the types of information which the Registry seeks and includes directions for transmitting such data to the Registry. The covering letter and placard were distributed to State and local radiological health program personnel, Bureau technical staff, Bureau advisory committee members, universities, industry, hospitals, laboratories, and other interested individuals.

Reported exposures that have all the information required for inclusion in the Registry are classified as reported incidents or reported potential incidents. In some cases, additional information is requested from individuals who are likely to have the needed information. In some instances, previously submitted reports may be deleted; e.g., further inquiry reveals that the reported incident did not involve a person exposed to electronic product radiation. Such reports and unsubstantiated reports are filed separately.

Reports of radiation incidents which have appeared in the professional literature are accepted in the Registry and regarded as public knowledge. However, this does not imply the Registry's acceptance of a cause-and-effect relationship and is not a judgment on conclusions reported in the literature.

Reported incidents and reported potential incidents that have not been published in the professional literature are subject to review by an advisory panel. The panel will review the clinical elements of the case and the possibility of the reported effects occurring from exposure to radiation from the equipment involved. Those incidents that cannot be fully documented will be catalogued separately. Members of the advisory panel will be chosen from the list of Consultants to the Bureau. The frequency with which the panel convenes will depend upon the quantity of material needing review. The panel's conclusions will be made available in future Registry reports.

The complete file on each incident is attached to a report form on which selected items have been entered. These items are coded using a modification of the U.S. Bureau of the Census, 1960 Census of Population Alphabetical Index of Occupations and Industries (revised edition), for occupational codes, and the Hospital Adaptation of the International Classification of Diseases (H-ICDA) 1968, for the classification of injuries. Additional codes were developed for other items. The data are then recorded and sorted with automatic data processing equipment.

DISCUSSION

Accepted reports of incidents and potential incidents have been subdivided into occupational and nonoccupational exposures, as shown in Appendix B. Reported incidents, Appendix B, Tables 1 and 2, are those in which a biological effect to an individual or group of individuals was noted. Reported potential incidents, Appendix B, Tables 3 and 4, are those in which exposure to radiation could have a biological effect, but no effect was apparent at the time of reporting. One incident reporting exposure to ultrasonic energy appears in Appendix B, Table 5. A brief summary of each incident appears in Appendix B, Tables 1-5. These summaries describing the reported incidents could assist individuals and agencies involved in radiation control programs.

Two compilations of workmen's compensation and radiation injury claims have provided additional data for the Registry (24,25). Appendix B, Tables 6-11, summarize these allegations of injuries from exposure to electronic product radiation. Each case has been identified in the tables by the same number that appears in the original reports.

Table 1 shows types of exposure according to the number of incidents, the number of persons involved, the number of injuries, and sex (excluding workmen's compensation claims). Skin damage was the most prevalent reported injury in the occupational ionizing group. A high number of reported eye injuries was noted in the occupational nonionizing group. Workmen's compensation and radiation injury claims are shown in Table 2. Again, skin damage is the most prevalent reported injury from exposure

Table 1. Number and types of exposure and selected characteristics of incidents reported to the Radiation Incidents Registry, as of December 1970 (excluding workmen's compensations claims).

Types of Exposure	Number of Incidents			Number of Persons			Number of Injuries[a]				Sex		
	Total	Biological Effects Noted	No Biological Effects Noted	Total	Injured	Not Injured	Eye	Skin	Blood	Other	M	F	[b]
Total	133	100	33	192	141	51	85	58	5	9	129	23	40
Occupational													
Ionizing	47	24	23	69	38	31	7	34	3	1	50	4	15
Nonionizing	71	69	2	84	77	7	64	12	2	7	67	11	6
Nonoccupational													
Ionizing	7	5	2	22	11	11	-	11	-	-	8	5	9
Nonionizing	7	1	6	16	14	2	14	1	-	-	3	3	10
Ultrasound	1	1	-	1	1	-	-	-	-	1	1	-	-

a/ Some persons had more than one injury.

b/ Not available.

Table 2. Number and types of exposure and selected characteristics of workmen's compensation and radiation injury claims included in the Radiation Incidents Registry, as of December 1970

Types of Exposure	Number of Incidents	Number of Persons Claiming Injury	Number of Injuries[a]				Sex		
			Eye	Skin	Blood	Other	M	F	[b]
All Claims	76	84	21	22	16	35	70	7	7
Workmen's Compensation and Bureau of Employees' Compensation									
Ionizing	39	39	8	5	14	17	35	4	-
Nonionizing	12	12	9	-	2	4	12	-	-
Both Ionizing and Nonionizing	3	3	3	-	-	-	3	-	-
Unknown	1	1	-	-	-	2	1	-	-
Common Law									
Ionizing	13	13	-	8	-	5	3	3	7
Company									
Ionizing	7	15	1	9	-	6	15	-	-
Unknown	1	1	-	-	-	1	1	-	-

a/ Some persons had more than one injury.
b/ Not available.

to ionizing radiation. Various forms of cancer were alleged as a result of exposure to radiation in the workmen's compensation and radiation injury claims. These claims of cancer and a wide range of other injuries appear in the "other" category in Table 2.

Figure 1 shows the percentage distribution of persons reportedly exposed to various types of radiation. The largest percentage of persons involved in all reported actual and potential incidents was in the ionizing radiation category (59 percent). Industrial x-ray units accounted for 24 percent of all persons involved in incidents resulting from exposure to x rays, and medical and dental x-ray units accounted for 22 percent of the total number of persons. Gamma radiation involved 5 percent of all persons reported exposed.

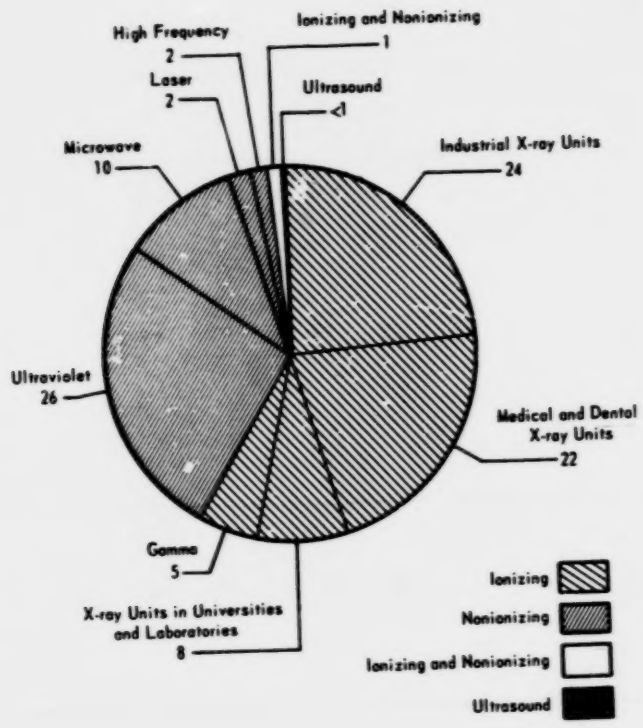

Figure 1. Percentage distribution of persons reported exposed to ionizing and nonionizing radiation and ultrasound. Radiation Incidents Registry, as of December 1970.

The specific types of industrial x-ray equipment involved in reported exposures included various types of accelerators, such as electrostatic generators, linear accelerators, and, in one instance, a gradient synchrotron. Other types of industrial x-ray equipment involved in reported exposures included x-ray thickness gauges, fluoroscopic and radiographic units, x-ray diffraction units, and x-ray spectrographic units.

The specific types of medical and dental equipment involved in reported x-ray exposures were high voltage therapy equipment, fluoroscopic and radiographic equipment, and electrostatic generators. Carelessness on the part of the operators and failure of the accelerators' interlock systems were the major causes of the reported exposures from industrial and medical and dental x-ray units.

X-ray equipment in universities and laboratories accounted for 8 percent of the total number of persons included in the Radiation Incidents Registry. Several reported potential incidents involved diffraction units used by students. In another potential incident, six graduate students were exposed to x rays from a linear accelerator when they succeeded in overriding the interlocks on the doors. The Registry also received reports of injury to laboratory workers using spectrographic equipment. Gamma radiation from a linear accelerator and from cyclotrons was involved in the incidents resulting from exposure to ionizing radiation.

Forty-one percent of all persons included in the Registry were reported exposed to nonionizing radiation. Occupational exposures to arc welding equipment and to ultraviolet equipment used in laboratories accounted for the majority of these incidents. Florida has provided the Registry with over 30 incidents involving employees' compensation claims that have resulted from accidental exposures to welding arcs. Reports of exposure to certain types of equipment, such as arc welders, may be classified separately in the future in order that the data do not appear disproportionate. The ultraviolet radiation produced by arc welding equipment resulted in moderate to severe eye burns. Most of the injuries were due to carelessness on the injured's part. The eye injuries that resulted from ultraviolet tubes used for germicidal purposes in a laboratory in Georgia were reportedly due to a lack of training, a failure of physical safeguards, or employees' carelessness.

Microwave-generating equipment and microwave radiation from ovens, radar, and one diathermy unit accounted for 10 percent of the persons involved in reported actual and potential incidents. Several incidents involving radar were reported in California, but there have been reservations about actual causal relationships between the reported deaths and radar radiation.

Persons reporting exposure to laser equipment in universities and laboratories accounted for 2 percent of the total number of persons included in the Registry. One report is included which involves a high school student who constructed his own ruby laser and also operated a borrowed helium-neon laser in his home. No injury was reported in this instance, but this incident does indicate that educational facilities, even at the high school level, need to emphasize safety precautions to protect students and teachers from the possible hazards of such equipment.

High frequency equipment accounted for 2 percent of persons involved in reported actual and potential incidents. Two of these incidents occurred in a manufacturing plant where a death and a severe burn were linked to radiation emitted from a high voltage machine designed to facilitate the lamination of wood products.

Three persons claiming employees' compensation reported exposure to both ionizing and nonionizing radiation. One of these individuals reported exposure to radar and x rays. Another reported exposure to radiation from high frequency and x rays, and the third reported exposure to microwaves and x rays.

The Registry has one reported incident resulting from exposure to ultrasonic energy. The individual reported severe discomfort (nausea and vertigo) when in the vicinity of ultrasonic alarm systems. Table 3 shows the specific types of equipment involved in reported actual and potential incidents, excluding workmen's compensation claims.

Table 4 shows the distribution of reported incidents in the 31 states that have contributed to the Registry thus far. Forty-five claims from the Bureau of Employees' Compensation, 5 company claims, and 1 common law claim were not identified by state and have been omitted from the table, as have the incidents that occurred in England, France, and Germany. The statistical significance of this table is limited by the small number of persons shown by states. Nevertheless, the table may be used to identify those areas in which program efforts could be directed. In the future, it may be possible to relate such information to the numbers and types of electronic equipment in use in the states. As the Registry progresses, statistical projections of the incidence of biological effects should be possible.

WORKMEN'S COMPENSATION AND RADIATION INJURY

The report by Thomas J. O'Toole, "Studies in Workmen's Compensation and Radiation Injury, Vol. II," (24) is based principally upon the examination of files of actual compensation cases in the Federal government and in a selected group of states. Thirty-nine incidents from Mr. O'Toole's report, pertaining to ionizing and nonionizing radiation from electronic products, were selected for the Radiation Incidents Registry from the Bureau of Employees' Compensation (BEC), California, Maryland, and New Jersey. Mr. O'Toole's report also includes a number of claims reported by a company and a number of common law claims. Eight of the claims made on the company and 13 common law claims, all pertaining to ionizing radiation, were selected for inclusion in the Registry. The Bureau of Employees' Compensation has jurisdiction over Federal employees. The claims against a company are usually filed with the State workmen's compensation board. Common law claims are not filed under Federal or State jurisdiction but against individuals or companies and involve negligence.

Table 3. Number and types of equipment involved in reported actual and potential incidents (excluding workmen's compensation claims). Radiation Incidents Registry, as of December 1970.

Ionizing Radiation				Nonionizing Radiation						Ultrasonics	
X ray		Accelerators		Ultraviolet		Laser		Microwave		High Frequency		Ultrasound	
Total	41		13		52		6		17		3		1
Analytical x-ray devices	19	Linear accelerator	9	Arc welding	32	Argon	2	Oven	8	High voltage machine	2	Alarm system	1
Industrial radiographic	9	Cyclotron	2	Germicidal lamp	16	Ruby	2	Radar	6	Radio-waves	1		
Medical radiographic	6	Electrostatic generator	1	Quartz mercury lamp	2	CO_2	1	Generator	2				
Medical fluoroscopic	3	Gradient synchrotron	1	Xenon lamp	1	Unknown type	1	Medical diathermy	1				
Therapeutic	2			Carbon arc lamp	1								
Industrial measuring gauges	2												

Table 4. Number of incidents and number of persons reported exposed to ionizing and nonionizing radiation and ultrasound according to region and state. Radiation Incidents Registry, as of December 1970.

Region and State	Number of Incidents					Number of Persons				
	Type of Radiation					Type of Radiation				
	TOTAL	Ionizing	Non-ionizing	Ultra-sound	Not Available	TOTAL	Ionizing	Non-ionizing	Ultra-sound	Not Available
All regions and states	155	76	77	1	1	205	104	99	1	1
Region I	6	4	2			14	12	2		
Connecticut		1	1				1	1		
Massachusetts		2	1				7	1		
New Hampshire		1					4			
Region II	10	6	4			13	7	6		
New Jersey		4	2				4	4		
New York		2	2				3	2		
Region III	16	13	3			34	17	17		
Dist. of Col.		4					5			
Maryland		5					5			
Pennsylvania		4	1				7	1		
Virginia			2					16		
Region IV	53	8	45			54	9	45		
Florida		2	36				2	36		
Georgia		2	9				2	9		
South Carolina		1					1			
Tennessee		3					4			
Region V	14	10	4			16	12	4		
Illinois		2	1				3	1		
Indiana		4					4			
Michigan		1	1				1	1		
Ohio		2	1				2	1		
Wisconsin		1	1				2	1		

Table 4. (Cont'd)

Region and State	Number of Incidents					Number of Persons				
	Type of Radiation					Type of Radiation				
	TOTAL	Ionizing	Non-ionizing	Ultra-sound	Not Available	TOTAL	Ionizing	Non-ionizing	Ultra-sound	Not Available
Region VI	15	7	8			20	8	12		
Arkansas		1					1			
New Mexico		1	6				2	8		
Oklahoma			1					1		
Texas		5	1				5	3		
Region VII	6	5	1			6	5	1		
Kansas		4					4			
Nebraska		1	1				1	1		
Region VIII	1	1				1	1			
Utah		1					1			
Region IX	26	16	8	1	1	39	27	10	1	1
Arizona		1					1			
California		15	7		1		26	9		1
Nevada			1	1				1	1	
Region X	8	6	2			8	6	2		
Idaho		1					1			
Oregon		1	2				1	2		
Washington		4					4			

The case experience within any selected jurisdiction can be assessed intelligently only in the light of that jurisdiction's statutory requirements concerning proof of causal connection. Since the cases collected from the workmen's compensation claims come from several jurisdictions, no single statutory pattern applies equally to all of them. An examination must be made of the local requirements on this issue of causal connection. Some of the difficulties of proof will be found to originate not so much in the special features of radiation cases as in the stringent standards of proof required in all claims for compensation under certain state laws.

Mr. O'Toole states that negative conclusions in BEC cases are bound to be on the high side because some cases appear to be filed to establish a record of radiation exposure regardless of the absence of pathological consequences. In these cases, causation is handled in the traditional manner of the common law. The claimant carries the burden of proof and the burden of going forward with the evidence. While the Bureau of Employees' Compensation very actively seeks to assist in the discovery of evidence in the possession of Federal agencies, it is the plaintiff who loses if the evidence is not discovered.

The other group of Bureau of Employees' Compensation claims, reporting exposure to ionizing radiation, were taken from "Studies in Workmen's Compensation and Radiation Injury, Vol. V." (25) These 16 claims and the 39 BEC claims reported by Mr. O'Toole are shown in Appendix B, Table 6. Exposures to nonionizing radiation are shown in Appendix B, Table 7. Appendix B, Table 8, shows three cases in which exposures to both ionizing and nonionizing radiation were reported. Appendix B, Table 9, shows the disposition made with respect to various claims, and includes the identification of cases involving each kind of injury or disease. Analysis of these claims reveals a wide variety of alleged delayed injuries or diseases.

The company included in Mr. O'Toole's report had over 19 years' experience, as of May 1965, with machine-generated radiation (Appendix B, Table 10). Of these 8 claims involving ionizing radiation, 9 persons received skin "burns," 5 persons received total body exposure, 1 developed cataracts, and 1 developed thyroid cancer. The burned individuals, and those who received total body exposure, were either treated by the company physicians or received medical expenses from the company. The person with cataracts did not pursue his claim, nor did the widow of the thyroid cancer patient.

The 13 common law cases selected from Mr. O'Toole's report date from 1926 through 1960 (Appendix B, Table 11). Of these, 8 were claims of burns, 1 was a claim of carcinoma, and 1 of neuroma, and 3 were for other injuries. Judgment for the plaintiff was awarded in 7 cases.

SUMMARY

The Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) calls for "a thorough appraisal, including statistical analyses, estimates, and long-term projectsions of biological injury and effects to the population resulting from exposure to electronic product radiation, with a breakdown, insofar as practicable, among the various sources of such radiation." The Radiation Incidents Registry established by the Bureau of Radiological Health has, after one year of operation, provided data on 209 reported incidents and reported potential incidents resulting from exposure to ionizing and nonionizing radiation and ultrasonic energy. These incidents include potential and overt biological injuries to 276 individuals.

Approximately 210 persons were reportedly exposed to electronic product radiation prior to October 18, 1968, and 66 have been reportedly exposed since October 18, 1968. No exposures to children under age 16 were reported. Fifty-seven individuals between the ages of 16 and 30, and 55 individuals between the ages of 31 and 44 were reportedly exposed. Over age 45, 36 individuals were involved. Age data on the remaining individuals were not available. There were 200 males, 31 females, and 45 whose sex was not reported.

Individuals were exposed in the following decreasing order by occupation: Technicians in the fields of engineering, physical science, and miscellaneous professional services, persons employed in electrical equipment industries, hospital personnel, and students performing experimental work in educational institutions.

Although the Bureau of Radiological Health accepts all reports of actual and potential injuries resulting from exposure to electronic product radiation, this in no way establishes a cause and effect relationship.

The incidents thus far recorded have been reported from 31 states and 3 foreign countries (England, France, and Germany). In addition, a number of incidents reported by the Bureau of Employees' Compensation have been included in the Registry. Of current entries, eye, skin damage, and various blood disorders were the most frequently reported effects due to electronic product radiation. The types of radiation which were involved include x rays, gamma, ultraviolet, microwave, laser, high frequency, and one report of severe discomfort resulting from exposure to ultrasonic energy. It is estimated that as the number of

devices employing sonic, infrasonic, and ultrasonic energy increases, there may be a corresponding increase in the number of unfavorable biological effects.

It is the tentative plan of the Registry to submit frequent reports on radiation incidents in the form of a pamphlet, "Radiation Incidents Registry Notes," to be issued three times yearly, and it is hoped that a format has been established upon which future annual reports can be based.

APPENDIX A

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APPENDIX B

Tables of Incidents Entered in Registry

Table 1. Reported Ionizing Radiation Incidents
Radiation Incidents Registry, as of December 1970.

Table 2. Reported Nonionizing Radiation Incidents
Radiation Incidents Registry, as of December 1970.

Table 3. Reported Potential Ionizing Radiation Incidents
Radiation Incidents Registry, as of December 1970.

Table 4. Reported Potential Nonionizing Radiation Incidents
Radiation Incidents Registry, as of December 1970.

Table 5. Reported Ultrasonic Incidents
Radiation Incidents Registry, as of December 1970.

Table 6. Workmen's Compensation Claims - Ionizing Radiation
Radiation Incidents Registry, as of December 1970.

Table 7. Bureau of Employees' Compensation Claims - Nonionizing Radiation
Radiation Incidents Registry, as of December 1970.

Table 8. Bureau of Employees' Compensation Claims - Exposure to Both Ionizing and Nonionizing Radiation
Radiation Incidents Registry, as of December 1970.

Table 9. Workmen's Compensation Claims - Disposition of Delayed Injury Claims from Ionizing and Nonionizing Radiation
Radiation Incidents Registry, as of December 1970.

Table 10. Company Claims - Ionizing Radiation
Radiation Incidents Registry, as of December 1970.

Table 11. Common Law Claims - Ionizing Radiation
Radiation Incidents Registry, as of December 1970.

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Table 1. Reported Ionizing Radiation Incidents. Radiation Incidents Registry, as of December 1970.

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
			Occupational			
California (1) a/	1965	Laboratory	X rays	Burns on fingers	NA b/	M
A laboratory research worker received exposure when he assumed that the x-ray machine was turned off, removed the temporary shielding, reached into the machine, and changed materials to be tested.						
Germany (2)	1961	Laboratory	X rays	Atrophy and depigmentation of skin of hand	23	M
Laboratory assistant was exposed while using fluorescence spectrograph.						
Illinois (3)	1965	Industrial facility	X rays	Swelling, erythema, eventual necrosis and amputation of hand and foot	NA	M
Industrial worker entered room through gap which accommodated conveyor system in order to place mold on conveyor belt and was exposed to a 10 MeV electron beam from linear accelerator.						
Indiana	During 1950's	Laboratory	X rays	Severe burns on fingers	NA	M
Laboratory technician thought fluorescence unit was shut off and was exposed while cleaning sample chamber.						
Indiana	1959	NA	X rays	Severe burns on fingers	NA	M
Technician cleaning window of fluorescence unit did not notice that it was still on.						
Indiana	1962 c/	NA	X rays	Acute radiodermatitis on hands	NA	M
Electronic repairman was exposed to primary rays of an x-ray thickness gauge.						
Indiana	1965 c/	NA	X rays	Radiodermatitis on finger	NA	M
Electronic repairman was exposed to primary rays of an x-ray thickness gauge.						

Table 1. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Kansas	1953	Industrial facility	X rays	Severe burns on hand	NA	M
Industrial worker carried out unnecessary and unauthorized experimentation with radiographic unit.						
Maryland	1928-1947	Physician's office	X rays	Erythema of fingers	NA	M
Physician exposed himself while using fluoroscope on patients.						
Maryland	1933-1966	Physician's office	X rays	Burns on fingers	28-61	M
Physician exposed himself while using a hand-held fluoroscope on patients.						
Massachusetts(4)	1944	Hospital	X rays	Skin and eye lesions	22,24 30,33 37,40	M
Six members of hospital staff entered room while electrostatic generator was in operation in order to observe fluorescence due to the electron beam.						
Michigan	1967	NA	X rays	Severe burns to exposed parts of body	NA	NA
Operator bypassed interlocks and inadvertently energized tube of fluorescence spectrograph during cleaning period.						
New Hampshire	1967[c]/	NA	X rays	Burns on fingers of one individual, no apparent injury to other three	NA	NA
Three operators were exposed to scattered radiation and a fourth was exposed to the primary beam of a spectrographic unit while attempting to ascertain why a sample holder was not operating properly. Interlocking device which should have prevented removal of sample holder, and beam shielding device, both failed.						

Table 1. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
New Mexico(5)	1960	Industrial facility	X rays	Overexposure to fingers and face	NA	M
Staff member and staff associate were exposed to electron beam from Van de Graaff accelerator while conducting radiation measurements.						
Pennsylvania	1965[c/]	Industrial facility	X rays	Burns on hands	NA	M
Two operators of a fluorescence unit were exposed for several weeks before it was discovered that interlock system was broken.						
Pennsylvania(6)	1967	Oil refining and research	X rays	Severe burns and blood disorders	39,31 29	M
An operator and two chemists were exposed to x-ray beam from a Van de Graaff accelerator while irradiating oil samples for activation analysis.						
Tennessee(7)	1965	Laboratory	X rays	Burns on fingers	NA,	M
Two employees were exposed during the course of a series of exposures when the radiographic unit started continuous operation due to an internal short.						
Tennessee(1)	1965	Atomic Energy Commission affiliate	X rays	Overexposure to fingers	NA	M
Physicist was exposed when beam shutter of Van de Graaff accelerator opened inadvertently while he was in target room making adjustments on experimental apparatus.						
Tennessee	1968	NA	X rays	Numbness in fingers	23	M
Employee performing experiment on radiographic unit short circuited door interlock so that he could be in the room while the machine was energized.						
Texas	1970	Industrial facility	X rays	Burns on hands	25	M
Employee received an overexposure when he failed to observe warning lights.						

Table 1. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Texas	1970	Laboratory	X rays	Moderate conjunctiva injection, blisters and erythema on fingers	32	M
Engineer was exposed to radiation from a spectrometer when he feared loss of a valuable specimen. Concern for its value led the operator to defeat interlocks without deactivating spectrometer.						
Washington(1)	1965	Laboratory	X rays	Burns on fingers	NA	M
Chemist was exposed to primary beam of an x-ray emission spectrometer when the shutter and safety latch failed to function properly.						
Washington(8)	1969	Atomic Energy Commission affiliate	X rays	Burns on hand	31	M
Scientist was exposed to radiation from diffraction unit when he forgot that he had left the unit "on" and propped open the port in order to perform various measurements.						
Wisconsin	1969	Paper mill	X rays	Erythema and pigmentation of fingers	21 24	M
Two paper mill workers were performing measurements of samples using an x-ray diffractometer when their hands were accidentally exposed to low energy radiation.						
			Nonoccupational			
England(9)	1961	Hospital	X rays	Severe burns on exposed parts of body	range 17-68	6-M 5-F
Patients treated for chronic eczematous lesions were exposed to overdoses of soft x rays when unit was operated at 50 kV instead of the recommended 10 kV.						

a/Numbers in parentheses refer to citations in bibliography.
b/Not available.
c/Extended period of exposure.

Table 2. Reported Nonionizing Radiation Incidents. Radiation Incidents Registry, as of December 1970.

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
			Occupational			
California(10)[a]	1952-1953	Microwave equipment manufacturing	Microwave	Death	28	F
Assembler was reportedly exposed to radar for six months. She hemorrhaged and died.						
California(10)	1952-1953	Microwave equipment manufacturing	Microwave	Paresthesia, general malaise	27	M
Administrator was reportedly exposed to radar and was diagnosed as having stress syndrome and temporary adrenal insufficiency.						
California(10)	1953-1955	Microwave equipment manufacturing	Microwave	Ecchymosis	26	F
Electronics assembler was reportedly exposed to radar and developed blood disorder.						
California(10)	1953-1955	Microwave equipment manufacturing	Microwave	Ecchymosis	39	M
Machinist was reportedly exposed to radar and developed blood disorder.						
California(11)	1954	Microwave equipment manufacturing	Microwave	Death	42	M
Electronics technician worked within ten feet of a radar transmitter. Tissue destruction and death were reported.						
California	1961	Laboratory	Ultraviolet	Skin and eye burns	NA[b]	M
Three laboratory employees reported skin and eye burns after exposure to ultraviolet xenon lamps.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
California(12)	1966	University laboratory	Laser	Edema of macula, much pigmenting	NA	M
Scientist received accidental macular burn from a Q-switched ruby laser.						
Connecticut	1968	Industrial products research and development	Laser	Permanent eye damage	41	M
A fully qualified expert in laser development violated established safety regulations while working with an Argon laser. He looked down the tube while aligning the mirrors and almost full power entered his eye.						
Florida	1965	Manufacturing plant	High frequency	Electrocution	NA	M
Foreman's death was linked to high voltage electrocution. He intentionally bypassed safety switches on a machine designed to facilitate lamination of wood products.						
Florida	1965	Manufacturing plant	High frequency	Severe burns	60	M
Operator's burns were reported to have been caused by high frequency radiation produced by a machine designed to dry glue in the lamination process.						
Florida	1969	Electronic engineering firm	Ultraviolet	Pain and reddening in eye	28	F
Junior assembler was reportedly overexposed to ultraviolet radiation from a carbon-arc lamp in defective Microtech alignment station lamp housing.						
Florida	1970	Sandwich shop	Microwave	Hand burn	33	F
Operator reported that she held sandwich in her hand while heating it in oven. Incident could not be duplicated but possibility of "one time" failure of interlock switch was not ruled out.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Florida	1967	Commercial printing company	Ultraviolet	Burned eyes	24	M
Pressman was exposing plates using a NuArc printing lamp when his eyes were burned.						
Florida	1969	Power line construction	Ultraviolet	Burned eyes	32	M
Linesman was exposed to an electrical flash.						
Florida	1969	Metal fabricating	Ultraviolet	Burned eyes	20	M
Welder received flash burn while assisting another welder.						
Florida	1969	Dairy processing	Ultraviolet	Burned eyes	44	M
Maintenance and Operations Engineer working with welder was burned in both eyes and face from arc weld.						
Florida	1970	Construction	Ultraviolet	Burned left eye	53	M
Ironworker received flash burn while working with welder.						
Florida	1970	Manufacturing	Ultraviolet	Burned eyes	28	F
Laborer working near arc welder received flash burn in eyes.						
Florida	1970	General construction	Ultraviolet	Burned eyes	NA	M
Welder apparently not wearing helmet properly received flash burn while arc welding.						
Florida	1970	Auto dealership	Ultraviolet	Burned eyes	24	M
Mechanic attempting to ignite arc weld lifted shield for better vision.						
Florida	1970	Dredging	Ultraviolet	Burned eyes	42	M
Shoreman working close to welder received flash burns.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Florida	1970	Service station	Ultraviolet	Burned eyes	24	M
Mechanic received arc welding flash in eyes.						
Florida	1970	Steel fabricating	Ultraviolet	Burned eyes	22	M
Burner received flash from welding arc used by person nearby.						
Florida	1970	Conservation	Ultraviolet	Burned eyes	21	M
Forest ranger was welding hasp on tool box and spot welded it with helmet up.						
Florida	1970	Welding	Ultraviolet	Burned eyes	21	M
Employee helping welder, failed to put on helmet.						
Florida	1970	Sewer and water plant construction	Ultraviolet	Corneal damage to eyes	24	M
Laborer received burn while watching welder.						
Florida	1970	Scaffolding manufacturing	Ultraviolet	Burned eyes	35	M
Yardman watched while welding was done.						
Florida	1970	Dredging	Ultraviolet	Burned eyes	32	M
Mate was helping welder and arc was set off before he could turn his head.						
Florida	1970	Plumbing	Ultraviolet	Burned eyes	24	M
Laborer was working near welder and was exposed to arc weld.						
Florida	1970	Cigar manufacturing	Ultraviolet	Burned eyes	27	M
Helper standing near welding job received flash burn in eyes.						
Florida	1970	Pipeline installation	Ultraviolet	Burn, left eye	42	M
Pipefitter helping welder received burn in left eye.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Florida	1970	General contracting	Ultraviolet	Burned eyes	22	M
Pipefitter helping welder received burns.						
Florida	1970	Rivet manufacturing	Ultraviolet	Burned eyes	23	M
Maintenance man received flash before hood was drawn down over his eyes.						
Florida	1970	Manufacturing	Ultraviolet	Burn, left eye	30	M
Mechanic received burn while welding with arc welder.						
Florida	1970	Wholesale bakery	Ultraviolet	Burned eyes	39	M
Mechanic helping to weld racks looked directly at the weld, or the arc reflected off metal.						
Florida	1970	Air conditioning, heating and plumbing	Ultraviolet	Burned eyes	32	M
Plumber working near welder received flash burns on eyes.						
Florida	1970	Tank manufacturing	Ultraviolet	Burned eyes	18	M
Helper received acute burns from electric arc flashes.						
Florida	1970	Steel fabricating	Ultraviolet	Burned eyes	20	M
Helper was "tack" welding and received flash burns.						
Florida	1970	Phosphate mining	Ultraviolet	Burned eyes	27	M
Laborer received flash burns while welding.						
Florida	1970	Electrical contracting	Ultraviolet	Burned eyes	34	M
Electrician bent down to check voltage on circuit and the equipment flashed in his face causing serious burning of the eyes.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Florida	1970	County incinerator	Ultraviolet	Burned eyes	32	M
Mechanic working with arc welding equipment did not use helmet properly.						
Florida	1970	Contracting	Ultraviolet	Burned eyes	23	M
Worker watched welder's arc unaware of possible harmful effect.						
Florida	1970	Manufacturing	Ultraviolet	Burned eyes	33	M
Welder burned eyes while working.						
France(13)	1963c/	NA	Microwave	Cataract	23	M
Radar technician developed bilateral capsular cataract.						
Georgia	1968	Laboratory	Ultraviolet	Conjunctivitis	35	F
Biological aide misunderstood instructions.						
Georgia	1968	Laboratory	Ultraviolet	Skin burns	25	F
Microbiologist used equipment that was considered unsafe.						
Georgia	1968	Laboratory	Ultraviolet	Conjunctivitis	50	M
Mechanic acted unsafely.						
Georgia	1968	Laboratory	Ultraviolet	Conjunctivitis	NA	M
Laborer failed to use personal protective devices.						
Georgia	1968	Laboratory	Ultraviolet	Conjunctivitis	25	F
Research chemist was careless while handling equipment.						
Georgia	1968	Laboratory	Ultraviolet	Conjunctivitis	19	M
Summer employee acted unsafely.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Georgia	1969	Laboratory	Ultraviolet	Conjunctivitis	50	M
Biological aide acted unsafely.						
Georgia	1969	Laboratory	Ultraviolet	Conjunctivitis	50	M
Laboratory worker acted unsafely.						
Georgia	1969	Laboratory	Ultraviolet	Conjunctivitis	NA	M
Biological aide acted unsafely.						
Illinois	1970	Restaurant	Microwave	"Tingling of skin"	53	F
Food manager tried to clean oven while it was in operation.						
Massachusetts(14)	1965	University	Laser	Hand burns	24	M
Technician was accidentally exposed to carbon dioxide laser, power output 14W, exposure time 0.5 second, wavelength 10.6μ.						
Michigan(15)	1969	Restaurant	Microwave	Syncopal episode	68	M
Physician with an implanted cardiac pacemaker was sitting near a microwave oven when he experienced a syncopal episode.						
New Jersey	1969	Flavoring manufacturing plant	Ultraviolet	Eyes burned	37 51	M
Assistant engineer and maintenance man inadvertently opened lid on top of sugar tank before turning off ultraviolet lamp.						
New Jersey	1970	Manufacturing plant	Microwave	Ocular symptoms manifested	NA	M
Two microwave oven surveyors reported eye discomfort after surveying defective equipment. One complained of blurred distant vision and later, mild tearing. The other complained of a tenseness in the eyes, headache, and a sensation that a foreign object was lodged at the back of the eyes.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
New Mexico(16)	1950-1951	Radio service shop	Microwave	Cataracts	32	M
Operator used equipment which included an experimental microwave generator. In order to determine whether or not the equipment was generating energy, he would look into the antenna and place his hand in the antenna.						
New Mexico	1959	Laboratory	Ultraviolet	Conjunctivitis	31,30	M&F
A scientist and a technician were exposed to ultraviolet light for "several minutes" while testing and adjusting a 2-meter grating spectrograph located in a glovebox. The small mercury lamp with quartz envelope which they used was brought outside the glovebox without being turned off.						
New Mexico	1960	Laboratory	Ultraviolet	Burning of the eyes	40	M
Staff member using a quartz mercury vapor lamp for calibration of a spectrograph, underestimated the source intensity and amount reflected. The lamp was only partially shielded while he worked.						
New Mexico	1964	Laboratory	Ultraviolet	Burning of the eyes	NA	M
Animal caretaker was believed to have been exposed to fluorescent ultraviolet lamps while cleaning the animal quarters.						
New Mexico	1968[c]/	Osteopath's office	Microwave	Cataracts	38	M
Twelve diathermy treatments to the right side of the neck were administered to a patient. (He was a Radiation Safety Officer.) Bilateral cataracts were reported several months later. Additional ultrasound diathermy treatments have been administered.						
New Mexico	1969	Laboratory	Ultraviolet	Burning of the eyes	NA	M
Two tinsmiths working on a ceiling ventilator were exposed for several hours to fluorescent ultraviolet germicidal lamps.						
New York(17)	1952-1958	Electronic plants	Microwave	Cataracts	51	M
Technical writer spent much time in the vicinity of microwave radiation and radiowave emitters in the course of his occupation. It was suggested that the lens changes were secondary to the microwave radiation.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Ohio(18)	1962-1967	Microwave oven repairs	Microwave	Eye irritations, skin lesions, genital complaints	40	M
Repairman was exposed to microwave ovens for several hours each working day.						
Oregon	1969c/	Welding area	Ultraviolet	Eye burns	23	M
Supervisor was standing near arc welding apparatus during erection of tanks.						
Texas	1969	Research laboratory	Ultraviolet	Burns of eyes and face	27,28 29	M
A technician and two entomologists were exposed to radiation from germicidal lamps for 20-40 seconds at close range. Eyes were sensitive to sunlight for seven months following incident.						
Wisconsin	1970	University	Laser	Nausea, headaches	53	F
Custodian reported that she was exposed to a laser beam as she walked past a university building.						
		Nonoccupational				
Florida	1963-1970	Home	Microwave	Dryness of tear glands	NA	F
Housewife experienced dryness of eyes and lack of tears. Had microwave oven in home for several years.						
Nebraska	1970	Laboratory	Ultraviolet	Burn on face and eyes.	20	M
Student worked for several hours within four feet of an ultraviolet sterilizer which had the interior painted aluminum.						
New York	1970c/	Home	Microwave	Slight eye burn	40	F
Housewife was presumably exposed to radiation from leaking microwave oven.						

Table 2. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Oregon(19)	1964	College	Laser	Macular burn	NA	M
Student, leaning over the apparatus from the side, was exposed to laser radiation when the argon tube accidentally discharged.						
Virginia	c/	Beauty school	Ultraviolet	Eye irritations	NA	NA
Several students and customers were exposed to two 30-watt unshielded ultraviolet lamps that were being used for germicidal purposes. Owner was advised to shield the lamps and no further incidents occurred.						

a/Number in parentheses refers to citation in bibliography.
b/Not available.
c/Extended period of exposure.

Table 3. Reported Potential Ionizing Radiation Incidents. Radiation Incidents Registry, as of December 1970

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
			Occupational			
California(20)[a]	1959	Industrial facility	Gamma	Overexposure	NA[b]	M
Seven physicists were exposed to gamma radiation from a linear accelerator while making a series of adjustments on beam defining plates. Reliance for safe operation had been placed on incomplete safety interlock circuits.						
California	1964	NA	Gamma	Not specified	NA	NA
Employee was exposed while removing targets that were bombarded by a cyclotron.						
California	1965	NA	Gamma	No clinical manifestation of injury	NA	NA
Employee was exposed during a beam tuning period while working in a cave adjacent to a cyclotron vault. There was a narrow crack in shielding wall between the cave and the vault.						
California	1965	NA	X rays	Overexposure	NA	NA
Employee was exposed to radiation from linear accelerator while making adjustments of focusing magnets.						
California	1967[c]	NA	X rays	Not specified	NA	NA
Employee received overexposure while tuning a klystron amplifier on a linear accelerator.						
District of Columbia	1934-1964	Dentist's office	X rays	Not specified	55 55	M F
Dentist and his assistant remained in the room and close to the x-ray machine during all x-ray examinations. The dentist also positioned and held the film in the patient's mouth.						

Table 3. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
District of Columbia	1964[c]/	Dentist's office	X rays	Not specified	NA	F
Dental receptionist routinely worked in an area where she could have been exposed to more than 100 mR/week. This was due to a lack of adequate shielding between her desk and the x-ray machine.						
District of Columbia	1966-1967	Physician's office	X rays	Not specified	55	M
Pediatrician was using a combination fluoroscopic-radiographic unit without proper safety precautions for himself or his patients.						
District of Columbia	1966[c]/	Physician's office	X rays	Not specified	NA	NA
Urologist routinely stood by examining table during all x-ray examinations.						
Georgia	1968	NA	X rays	Not specified	NA	NA
Exposure was due to a porthole cover being left open on diffraction machine.						
Georgia	1968	NA	X rays	Not specified	NA	NA
Diffraction unit was energized without the operator's knowledge.						
Illinois	1963	NA	X rays	Not specified	NA	NA
Two operators were exposed while making adjustments on a gradient synchrotron. Incorrect beam stopper had been inserted and employees carried on assignment unaware of this.						
Kansas	1969	Hospital	X rays	Not specified	19	F
X-ray operator was exposed due to faulty timer switch on mobile unit.						
Maryland	1963[c]/	Podiatrist's office	X rays	Overexposure	NA	M
Podiatrist placed patient's foot on step and made the exposure in a squat position in front of the step.						

Table 3. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Maryland	1965	Industrial facility	X rays	Overexposure	NA	M
Operator received whole body exposure when safety precautions were not observed during radiographic inspection of industrial equipment.						
Massachusetts	1968	NA	X rays	Overexposure	NA	NA
Operator received dose in excess of allowable limits during period of changeover from a large shield to a smaller one on a diffraction unit.						
Pennsylvania	1969	Petroleum refining	X rays	Not specified	NA	M
Technician was reportedly exposed as a result of failure of the shutter mechanism on an x-ray diffraction unit.						
South Carolina	1970[c]/	Hospital	X rays	Not specified	24	M
X-ray technologist was reportedly exposed during normal course of duties.						
Texas	1969	Therapy center	X rays	Not specified	26	F
Technician entered the irradiation room to check patient's position without knowing that the high voltage machine had been turned on.						
Texas	1970	Bridge and iron company	X rays	Not specified	27	M
Welder was exposed to x rays when radiographer turned the machine on not noticing that welder was close by.						
Texas	1970	Oil refinery	X rays	Not specified	48	M
Radiation safety officer received whole body exposure while surveying around a diagnostic unit.						

Table 3. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Utah(21)	1967	Air Force Base	X rays	Not specified	NA	M
Operator was accidentally exposed to x rays from linear accelerator due to failure of timer mechanism and interlock system.						
Washington(22)	1970	Naval shipyard	X rays	Not specified	24	M
Employee failed to observe meters on x-ray control panel and entered radiography cell while high voltage alternator was operating.						
			Nonoccupational			
California	1967	University	X rays	Not specified	NA	NA
Six graduate students who were involved in initial tune-up of linear accelerator entered a high radiation area by overriding the interlocks on the doors that prevented access to the area.						
Idaho	NA	University	X rays	Not specified	NA	NA
Student was exposed while attempting a functional changeover from diffraction unit to spectrographic unit.						
Kansas	1969	University	X rays	Not specified	NA	M
Student operator of x-ray diffraction unit inadvertently placed his hand in the path of x-ray beam.						
Ohio(23)	1969	University	X rays	Not specified	21	NA
Graduate student inserted fingers into the beam of x-ray diffraction unit in order to remove samples from holder.						

Table 3. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Ohio(23)	1969	University	X rays	Not specified	21	NA
Another graduate student inserted fingers into the beam of x-ray diffraction unit in order to remove samples from holder.						
Washington	1968	University	X rays	Overexposure	NA	M
Graduate student was exposed to primary beam and scatter from diffractometer when fault in the control circuit permitted tube to remain energized.						

a/Number in parentheses refers to citation in bibliography.
b/Not available.
c/Extended period of exposure.

Table 4. Reported Potential Nonionizing Radiation Incidents. Radiation Incidents Registry, as of December 1970.

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Occupational						
Nevada	1967	Police Station	Microwave	Face felt warm	36	M
Technician reportedly received radiation from waist to head when an interlock on a microwave oven door failed. The door was raised and fully opened, momentarily exposing the subject.						
Virginia	[c]	Manufacturing plant	Ultraviolet	Not specified	NA[b]	NA
Several plant employees were exposed to ultraviolet lamps being used in the ceiling of one room for sanitation purposes. Management was advised to shield the lamps.						
Nonoccupational						
Oklahoma	1968[c]	Home	High frequency	Vague health complaints	38	F
Housewife residing very near a radio station complained of health effects and specific damage to small household appliances, probably due to tremendous flux of radiowaves emitted from station.						
Pennsylvania	1968[c]	Home	Laser	Not specified	16	M
Student operated laser intermittently for one month. Goggles were not worn.						

[b]/Not available.
[c]/Extended period of exposure.

Table 5. Reported Ultrasonic Incidents. Radiation Incidents Registry, as of December 1970.

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex
Nevada	1968[c/]	Retail establishments and entertainment places	Ultrasonic	Nausea, vertigo	30	M
Health physicist reported discomfort upon hearing emissions from ultrasonic alarm systems.						

c/Extended period of exposure.

Table 6. Workmen's Compensation Claims (24,25) - Ionizing Radiation. Radiation Incidents Registry, as of December 1970.

Location[a]	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
California (F-1)	1943-1960	NA[b]	X rays	Radiodermatitis, keratosis	39	M	Dentist
California (F-2)	22 years	NA	X rays	Radiodermatitis, keratosis	56	M	Dentist
California (F-3)	1948-1962	NA	X rays	Prickly sensation, fatigue	46	F	X-ray technician
California (F-4)	1950-1958	NA	X rays	Acute leukemia	52	F	Production control clerk
California (F-5)	15 years	NA	X rays	Cancer	50	M	Dentist
California (F-7)	1954-1963	Hospital	X rays	Leukemia	37	M	X-ray technician
California (F-12)	1950-1956	Radiation laboratory	Gamma	Cataracts, mild glaucoma	38	M	Physicist
Maryland (E-1)	1939-1950	Public Health Department	X rays	Blood disorder	33	M	Medical x-ray technician
New Jersey (H-1)	NA	Industrial facility	X rays	Anxiety reaction, dermatitis	NA	M	Chemist
New Jersey (H-2)	2 years	NA	X rays	Anxiety reaction, dermatitis	22	F	Dental technician
BEC (A-1)	5½ years	NA	NA	Anxiety reaction, throat complaint	30	M	Health physicist
BEC (A-4)	1931-1961	Hospital	X rays	Anxiety reaction, blood disorder	64	M	Radiology
BEC (A-7)	1952-1964	NA	X rays	Blood disorder	33	F	Medical x-ray technician

Table 6. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC (A-9)	NA	NA	X rays	Cancer	NA	M	Medical x-ray technician
BEC (A-14)	1½ years	Hospital	X rays	Blood disorder	32	M	Physician
BEC (A-21)	NA	NA	X rays	Cancer	50	M	Electronic technician
BEC (A-31)	1941-1942	Industrial facility	X rays	Cancer	40	M	Inspector
BEC (A-34)	1962	NA	X rays	Fatigue	41	M	Inspector
BEC (A-38)	1951-1960	NA	Gamma	Cancer	47	M	Air traffic control officer
BEC (A-44)	9-10 years	NA	X rays	Cataracts	44	M	Electrical technician
BEC (A-45)	1951-1959	NA	X rays	Lens opacities	42	M	Radioactivity inspector
BEC (A-48)	2/62-3/63	NA	X rays	Blood disorder	31	M	Electrician
BEC (A-50)	NA	NA	X rays	Lens opacities	56	M	Quality control assistant
BEC (A-54)	1955-1956 1958-1959	Industrial facility	X rays	Cancer	59	M	Inspector
BEC (A-55)	1951	NA	X rays	Lens opacities	50	M	Quality control

Table 6. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC 2	1941-1955	Government installation	X rays	Lymphosarcoma	NA	M	Welding inspector
BEC 7	1950-1964	Hospital	Gamma	Blood disorder	NA	M	X-ray technician
BEC 8	1957-1966	Government installation	X rays	Blood disorder	NA	M	Medical radiology technician
BEC 9	1953-1961	Hospital	X rays	Blood disorder	NA	M	Physician
BEC 10	1948-1959	NA	X rays	Intestinal disorders and anemia	NA	M	X-ray technician
BEC 11	1952-1964	Hospital	X rays	Blood disorder	NA	M	X-ray technician
BEC 12	1955-1959	Government installation	X rays	Cataracts	NA	M	Electronics inspector
BEC 13	1930-1961	Government installation	X rays	Osteoarthritis, blood disorder	66	M	Radiology technician
BEC 14	1952-1959	Industrial plants	X rays	Adenocarcinoma	59	M	Welding and optical element inspector

Table 6. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC 29	1943c/	Laboratory	X rays	Skin cancer	NA	M	Assistant engineering aide
BEC 31	c/	NA	X rays	Eye disease	NA	M	Welder
BEC 35	1948-1956	Dental clinic	X rays	Glaucoma	NA	M	Dentist
BEC 36	1958	NA	X rays	Erythema of chest wall and scrotum, headaches	NA	M	Shipwright
BEC 38	1946-1957	Government installation	X rays	Lymphosarcoma	NA	M	X-ray technician
BEC 54	1966c/	Hospital	X rays	Anemia	NA	M	NA

a/ Number in parentheses from reference 24/. Number in italics from reference 25/.

b/ Not available.

c/ Extended period of exposure.

Table 7. Bureau of Employees' Compensation Claims (24) - Nonionizing Radiation. Radiation Incidents Registry, as of December 1970.

Location[a]	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC (A-6)	1954-1957	NA[b]	Microwaves	Lens opacity	42	M	Electronic inspector
BEC (A-11)	NA	NA	Radar	Eye trouble, fatigue	35	M	Ground radar repairman
BEC (A-12)	12 years	NA	High frequency	Brain atrophy	50	M	Radio engineer
BEC (A-24)	1960-1963	Shop and in field	Radar	Lens opacity	42	M	Electronic mechanic
BEC (A-25)	NA	NA	High frequency	Lens opacity	35	M	Radio mechanic
BEC (A-26)	1962-1964	NA	Radar	Lens opacity	34	M	Radar electrician
BEC (A-28)	1953-1963	NA	Radar	Eye trouble	35	M	Electronic technician
BEC (A-30)	½ hour	NA	Radar	Lens opacity, emphysema	48	M	Painter
BEC (A-32)	1959	NA	Microwaves	Lens opacity	42	M	Quality contract inspector

Table 7. (Cont'd)

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC (A-40)	6 years (routinely) 12 years (occasionally)	NA	Radar	Cataract	50	M	Aircraft inspector
BEC (A-42)	NA	NA	Radar	Leukemia	26	M	Property and supply clerk
BEC (A-53)	8 years	NA	Radar	Blood disorder, fatigue	39	M	Electric equipment installer

a/ Number in parentheses is same as in original report, reference 24/.

b/ Not available.

Table 8. Bureau of Employees' Compensation Claims (24,25) - Exposure to Both Ionizing and Nonionizing Radiation. Radiation Incidents Registry, as of December 1970.

Location[a/]	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Age	Sex	Occupation
BEC (A-27)	5 years	NA[b/]	High frequency, X rays	Eye trouble	37	M	Radar mechanic and inspector
BEC (A-43)	1947-1957	NA	Radar, X rays	Cataracts	47	M	Physicist
BEC 24	1942-1950	Government installation	Microwaves, X rays	Cataracts	NA	M	Geophysical research scientist

a/ Number in parentheses from reference 24/. Number in italics from reference 25/.

b/ Not available.

Table 9. Workmen's Compensation Claims (24,25) - Disposition of Delayed Injury Claims from Ionizing and Nonionizing Radiation. Radiation Incidents Registry, as of December 1970.

Type of Delayed Injury	Total Number of Injuries	Disposition					
		Granted	Case Identification[a]	Denied	Case Identification[a]	Other	Case Identification[a]
All Types	63	12 (19%)		36 (57%)		15(24%)	
Anxiety Reaction	4	2	H-1, H-2	2	A-1, A-4	-	
Blood Disorders (except leukemia)	14	3	E-1, *8*, *54*	8	A-4, A-14, A-53 *7*, *9*, *10*, *11*, *13*	3	A-7, A-48, F-3
Cancer (except leukemia)	8	2	A-31, F-5	6	A-9, A-21, A-38, A-54, *14*, *29*	-	
Dermatitis	5	2	H-1, H-2	1	*36*	2	F-1, F-2
Eye Trouble (except lens opacities)	5	-		4	A-27, A-28, *31*, *35*	1	A-11
Fatigue	4	-		1	A-53	3	A-11, A-34, F-3
Leukemia	2	-		1	A-42	1	F-7
Lens Opacities	15	2	F-12, *24*	9	A-24, A-25, A-26 A-32, A-40, A-43 A-44, A-55, *12*	4	A-6, A-30, A-45, A-50
Emphysema	1	-		-		1	A-30
Throat Complaint	1	-		1	A-1	-	
Brain Atrophy	1	-		1	A-12	-	
Lymphosarcoma	2	1	*2*	1	*38*	-	
Hearing Loss	1	-		1	*31*	-	

a/ A = Bureau of Employees' Compensation, E = Maryland, F = California, H = New Jersey, from reference 24/. Number in italics from reference 25/ .

Table 10. Company Claims (24) - Ionizing Radiation. Radiation Incidents Registry, as of December 1970.[a/]

Location	Exposure History	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Occupation
New York	1956	Industrial facility	X rays	Burns on hands	Physicians - 2
NA[b/]	NA	Industrial facility	NA	Thyroid cancer	Laboratory worker
New York	NA	Industrial facility	X rays	Burns on finger	NA
NA	1954	Industrial facility	X rays	Dermatitis on finger	NA
NA	1960	Industrial facility	X rays	Burns on fingers	NA
Florida	NA	NA	X rays	Cataracts	NA
NA	1960	NA	X rays	Burns	NA - 4 men
NA	NA	Hospital	X rays	Whole-body exposure	NA - 5 men

a/ Age and sex data were considered unreliable and have been omitted from this table.

b/ Not available.

Table 11. Common Law Claims (24) - Ionizing Radiation. Radiation Incidents Registry, as of December 1970.[a/]

Location	Claim Date	Type of Facility Where Incident Occurred	Type of Radiation	Reported Effects	Occupation
Arizona	1926	Hospital	X rays	Burn in groin	NA[b/]
Arkansas	1927	NA	X rays	Burn on arm	NA
NA	NA	NA	X rays	Cyanosis of skin, impaired vision	NA
Connecticut	1937	Dental facility	X rays	Ulcer on finger	Dentist
Pennsylvania	1937	Dental facility	X rays	Ulcer on finger	Dentist
Nebraska	1942	Dental facility	X rays	Ulcer on finger, portion of hand amputated	Dentist
Florida	1944	Beauty parlor	X rays	Ulceration on face	NA
California	1947	NA	X rays	Neuroma on scar	NA
New Jersey	1949	NA	X rays	Premature menopause and telangiectasis	Fluoroscoped rubber beltings
Oregon	1950	NA	X rays	Uterine burn	NA
New Jersey	1951	NA	X rays	Carcinoma on hand	X-ray technician
California	1953	NA	X rays	Osteomyelitis	NA
Kansas	1960	NA	X rays	Atrophy of skin	NA

a/ Age and sex data were considered unreliable and have been omitted from this table.
b/ Not available.

EXHIBIT B - PLACARD

RADIATION INCIDENTS REGISTRY

BUREAU OF RADIOLOGICAL HEALTH
PUBLIC HEALTH SERVICE
ENVIRONMENTAL HEALTH SERVICE
5600 FISHERS LANE
ROCKVILLE, MARYLAND 20852

Your cooperation is solicited in reporting to the **RADIATION INCIDENTS REGISTRY** of the Bureau of Radiological Health, all radiation incidents (other than those reportable to the Atomic Energy Commission) resulting from exposure to ionizing or nonionizing radiation, and sonic, infrasonic, or ultrasonic radiation emitted as a result of the operation of an electronic circuit in an electronic product. Both deleterious and potentially deleterious exposures are to be considered as reportable incidents.

Radiation Incident Reports should be submitted by a reporting agency whenever such incidents occur. Any standard report forms or the following guidelines may be used for reporting incidents:

1. When, where, how incident occurred.
2. Type of radiation involved and estimated exposure.
3. Age, sex, occupation, estimated number of employees.
4. Effects noted, medical treatment given.

Radiation Incident Reports or any inquiries regarding items to be included in the **REGISTRY** should be forwarded to your State Radiation Control Program or directly to the **RADIATION INCIDENTS REGISTRY**, Bureau of Radiological Health, at the above address.

The Radiation Incidents Registry is maintained under the authority of the Radiation Control for Health and Safety Act of 1968 (42 U.S.C. 263b et seq.).

EXHIBIT A - COVERING LETTER

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
ENVIRONMENTAL HEALTH SERVICE
ROCKVILLE, MARYLAND 20852

ENVIRONMENTAL CONTROL
ADMINISTRATION

May 1, 1970

Dear Sir:

The passage of the Radiation Control for Health and Safety Act of 1968 (Public Law 90-602) reflects the need for registering injurious or potentially injurious exposures to electronic product radiation. This includes any ionizing or nonionizing electromagnetic radiation and any sonic, infrasonic, or ultrasonic radiation which is emitted from an electronic product as the result of the operation of an electronic circuit in such product. Accurate and reliable data on the exposure of the population to such sources of radiation are essential to the successful implementation of P.L. 90-602. As stated in P.L. 90-602, a thorough appraisal, including statistical analyses, estimates, and long-term projections of biological injury and effects to the population resulting from exposure to electronic product radiation, with a breakdown, insofar as practicable, among the various sources of such radiation, is to be transmitted annually to the Congress.

The Bureau of Radiological Health has established a Radiation Incidents Registry. The Registry will serve as a baseline to evaluate various program efforts as well as to develop future programs to reduce excess radiation exposure from electronic products. The Bureau of Radiological Health will also report on a regular basis on the types of incidents that are occurring. We are asking your cooperation in publicizing the Registry.

The enclosed placard should be posted in locations where individuals who would have knowledge of such incidents would see it. We emphasize the importance of displaying the placard in a conspicuous location where it would be likely to remain for an extended period of time.

All information pertaining to individuals or facilities will be treated confidentially; only statistical analyses and interpretation of the data will be made available for publication.

Your assistance in displaying the placard is greatly appreciated. We shall be happy to answer any questions that you may have. Please direct all inquiries to the Radiation Incidents Registry of the Bureau of Radiological Health.

Sincerely yours,

John C. Villforth
Director
Bureau of Radiological Health

Enclosure

APPENDIX C

Exhibits Soliciting Incidents for Registry

Exhibit A. Covering Letter

Exhibit B. Placard

The ABSTRACT CARDS below are designed to facilitate document retrieval using Coordinate Indexing. They provide space for an accession number (to be filled in by the user), suggested keywords, bibliographic information, and an abstract.

The Coordinate Index concept of reference material filing is readily adaptable to a variety of filing systems. Coordinate Indexing is described in the publication "IBM Data Processing Techniques - Index Organization for Information Retrieval" (C 20-8062). Copies are available through IBM Branch Offices.

The cards are furnished in triplicate to allow for flexibility in their use (for example, author card index, accession number card index).

L. F. Mills, P. Segal: RADIATION INCIDENTS REGISTRY REPORT 1970

Accession No.

U.S. Department of Health, Education, and Welfare, Public Health Service, Bureau of Radiological Health. BRH/DBE 70-6 (December 1970) 55 pp.

ABSTRACT: The Radiation Incidents Registry established by the Bureau of Radiological Health has, after one year of operation, provided data on 209 reported incidents and reported potential incidents resulting from exposure to ionizing and nonionizing radiation and ultrasonic waves. These incidents include potential and overt biological injuries to 276 individuals. Approximately 210 persons were reportedly exposed to electronic product radiation prior to the passage of the "Radiation Control for Health and Safety

(over)

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(over)

Act of 1968", and 66 have been reportedly exposed since October 18, 1968. No exposures to children under age 16 were reported. Fifty-seven individuals between the ages of 16 and 30, and 55 individuals between the ages of 31 and 44 were reportedly exposed. Over age 45, 36 individuals were involved. Age data on the remaining individuals were not available. There were 200 males, 31 females, and 45 whose sex was not reported.

KEYWORDS: Biological Effects; Electromagnetic Radiation; Ionizing Radiation; Lasers; Microwaves; Nonionizing Radiation; Radiation Effects; Radiation Incidents; Radiation Injuries; Ultrasonics; Ultraviolet; X rays.

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